単純せん断におけるロスの理論に基づく粒状体のエントロピー

諸　戸　靖　史

Entropy of granular materials based on Wroth's Theory under simple shear condition

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Abstract

The author found out that the plastic work done under the simple shear condition is largely dependent on the stress paths and the following quontity S comes to be an interesting state parameter:

$$S=\int dW^p/\sigma'$$

where dW^p is the increment of plastic work done and σ' is the effective normal stress. He newly defines the state parameter S as 'entropy of granular materials'. The above finding is based on the Wroth's theory.

Wroth proposed a complete deformation relationship of granular material in simple shear (Wroth and Basset, 1965). In this paper, the present author defined entropy of granular material based on Wroth's theory.

In Wroth's theory, the following three fundamental equations are employed:

(1) Equation to specify the loading path of test on the e-lnσ' plane

$$e-e_0=\alpha\ ln(\sigma'/\sigma'_0) \quad \cdots\cdots(1)$$

(2) Equation of energy balance

$$\tau=\sigma'+\sigma'\frac{\partial e}{\partial z}+\chi\frac{\partial \sigma'}{\partial z} \quad \cdots\cdots(2)$$

(3) Empirical equation to express dilatancy performance

$$\frac{e-e_x+\lambda\ ln(\sigma'/\sigma'_x)}{D_0}=\frac{\chi}{\chi_0}=(1+bz)\exp(-az)\equiv F(z) \quad \cdots\cdots(3)$$

where M, λ, χ: material constants and D_0, a, b, e_0, σ_0: tests constants.

σ': vetrical stress (effective)　　τ: shear stress

e: void ratio　　z: shear strain

The stress-strain equation can be expressed as

$$\frac{\tau}{\sigma'}=M\left(1-\frac{1}{b-a}(b-a-abz)\exp(-az)\right) \quad \cdots\cdots(4)$$

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